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Stretching before sleep reduces the frequency and severity of nocturnal leg cramps in older adults: a randomised trial

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Question: In adults who experience nocturnal leg cramps, does stretching of the calf and hamstring muscles each day just before sleep reduce the frequency and severity of the cramps? **Design:** A randomised trial with concealed allocation and intention-to-treat analysis. **Participants:** Eighty adults aged over 55 years with nocturnal leg cramps who were not being treated with quinine. **Intervention:** The experimental group performed stretches of the calf and hamstring muscles nightly, immediately before going to sleep, for six weeks. The control group performed no specific stretching exercises. Both groups continued other usual activities. **Outcome measures:** Participants recorded the frequency of nocturnal leg cramps in a daily diary. Participants also recorded the severity of the pain associated with nocturnal leg cramps on a 10-cm visual analogue scale. Adverse events were also recorded. **Results:** All participants completed the study. At six weeks, the frequency of nocturnal leg cramps decreased significantly more in the experimental group, mean difference 1.2 cramps per night (95% CI 0.6 to 1.8). The severity of the nocturnal leg cramps had also decreased significantly more in the experimental group than in the control group, mean difference 1.3 cm (95% CI 0.9 to 1.7) on the 10-cm visual analogue scale. **Conclusion:** Nightly stretching before going to sleep reduces the frequency and severity of nocturnal leg cramps in older adults. **Trial registration:** NCT01421628. [Hallegraeff JM, van der Schans CP, de Ruiter R, de Greef MHG (2012) Stretching before sleep reduces the frequency and severity of nocturnal leg cramps in older adults: a randomised trial. *Journal of Physiotherapy* 58: 17–22]

Key words: Nocturnal leg cramps, Muscle stretching exercises, Older adults

Introduction

Nocturnal leg cramps are suddenly occurring, episodic, painful, sustained, involuntary muscle contractions of the calf muscles, hamstrings, or foot muscles (Monderer et al 2010, Sontag and Wanner 1988). During the cramp, the involved muscles are tender and hard on palpation. The pain that occurs with these contractions is sharp and intense and may last from seconds to several minutes. Although they are otherwise benign, nocturnal leg cramps can cause substantial distress and can disrupt sleep. In 20% of people who experience nocturnal leg cramps, cramps also occur during the daytime (Monderer et al 2010). The cramps sometimes occur in episodes a few days a week, during which they repeat themselves (Kanaan and Sawaya 2001, Stewart et al 1993, Monderer et al 2010). Although the insults generally persist for no longer than ten minutes, in exceptional situations they can continue for several hours. In approximately 2% of cases, nocturnal leg cramps occur weekly (Abdulla et al 1999). Nocturnal leg cramps occur more commonly with advancing age, affecting between 38% and 50% of the elderly (Butler et al 2002, Abdulla et al 1999, Sontag and Wanner 1988). Nocturnal leg cramps are more prevalent among women and among people with comorbidities, especially those with neurological and cardiovascular diseases (Butler et al 2002, Stewart et al 1993).

It is important to distinguish nocturnal leg cramps from restless legs syndrome and periodic limb movement disorder, because all are sleep disorders characterised by abnormal leg movements and reduced sleep quality. However, restless legs syndrome involves more continuous discomfort and the urge to move the legs, occurs during the day also, and is relieved by movement. Periodic limb movement disorder causes involuntary limb movements (primarily of the legs) during sleep, recurring at brief intervals, but not necessarily waking the person (Khassanweh 2005). Therefore, the diagnosis of nocturnal leg cramps can be based on reports of episodes of painful involuntary contractions of muscles, affecting the leg, calf, or foot, which occur at night and which recur at sporadic intervals (Kanaan and Sawaya 2001, Butler et al 2002).

What is already known on this topic: Nocturnal leg cramps are common among the elderly, causing pain and sleep disturbance. The medications used to prevent nocturnal leg cramps have variable efficacy and may have substantial side effects.

What this study adds: Nightly stretching of the calves and hamstrings reduces the frequency of nocturnal leg cramps in older adults. Nightly stretching also lessens the pain associated with any cramps that continue to occur.

The cause of nocturnal leg cramps is unknown. However, several possible causes and precipitating factors have been hypothesised. Abnormal excitability of motor nerves, perhaps due to electrolyte imbalance, may be a contributing mechanism (Monderer et al 2010). Diuretics, steroids, morphine, and lithium are also reported to cause nocturnal cramps, as can repetitive movements during sport (Butler et al 2002, Kanaan and Sawaya 2001, Monderer et al 2010). Conversely, physical inactivity has been proposed as a cause, with inadequate stretching leading to reduced muscle and tendon length (Monderer et al 2010, Sontag and Wanner 1988). Although it is not fully understood how this could lead to nocturnal leg cramps, this would be consistent with the higher prevalence of the disorder among people with reductions in lower limb activity and joint range, such as those with varicose veins and arthritis (Abdullah et al 1999, Stewart et al 1993, Sontag and Wanner 1988, Hirai 2000).

Quinine and hydroquinine are moderately effective in reducing the frequency and severity of nocturnal leg cramps (El-Tawil et al 2010, van Kan et al 2000), perhaps by decreasing the excitability of the motor end plate and thereby increasing the refractory period of a muscle (Vetrugno et al 2007). However, quinine can have important side effects, especially for women, such as: thrombocytopenia, hepatitis, high blood pressure, tinnitus, severe skin rash, and haemolytic uremic syndrome (Aronson 2006, Inan-Arslan et al 2006). If hydroquinine is used, a trial intervention period is advised to monitor side effects (Monderer et al 2010, Inan-Arslan et al 2006). Although other medications have been used to treat nocturnal leg cramps such as magnesium, Vitamin B Complex Forte, calcium, and vitamin E, none of these appears to be effective (Anonymous 2007, Daniell 1979).

Muscle stretching is worth considering as an alternative therapy. It is easy to perform, has a very low risk of side effects, and often relieves the pain when a cramp has occurred. Moreover, stretching techniques can foster a resilient attitude toward recovery in patients with nocturnal leg cramps by promoting a 'bounce back and move on' behavioural strategy (Norris et al 2008), because they give patients a strategy to seek immediate relief.

Daniell (1979) examined a program of calf-stretching exercises performed three times per day by people with nocturnal leg cramps. Although the program of stretches appeared to prevent nocturnal leg cramps, the study lacked a randomised control group for comparison. In contrast, Coppin and colleagues (2005) performed a randomised controlled trial in which the stretching exercises failed to decrease the frequency and severity of nocturnal leg cramps in older adults. However, in this study all participants were already taking quinine at baseline and continued taking it throughout the study, which may have reduced the potential for stretching to affect the outcome. Also, the stretching was performed three times 'spread through each day' without further prescription or recording of the actual times. Because nocturnal leg cramps occur primarily at night and may be associated with physical inactivity and muscle shortening, stretching immediately before sleep may be a useful preventative therapy. Therefore, the research question for this study was:

In older adults who suffer from nocturnal leg cramps, does a 6-week program of stretching the hamstring and

calf muscles immediately before going to bed reduce the frequency and severity of the cramps?

Method

Design

A randomised trial was conducted at a physical therapy clinic in Groningen, with participants recruited through advertisement in local newspapers in the northern part of the Netherlands. At baseline, each participant's age, gender, and history of nocturnal leg cramps were recorded. After eligibility was verified and written informed consent was obtained, participants underwent measurement of their body mass index, daily physical activity, and functional lower limb strength, as described in detail below. Participants were then randomised to either an experimental (daily stretches before sleep) or a control (no stretching) group, based on a computer-generated assignment schedule that was coded and concealed until after the study. An independent researcher assigned each patient to either the experimental group or the control group. Participants allocated to the experimental group were taught the stretches and those in the control group were advised not to stretch. Other investigators and care providers were blinded to group assignment. Outcome measures were cramp frequency and severity, recorded by participants daily in a diary during Week 0 and Week 6.

The methods used to characterise participants at their baseline visit were as follows. Body mass index was calculated from height and weight, which were measured on calibrated instruments. Daily physical activity was measured by a pedometer^a fitted to each participant's belt

Box 1. Description of the stretching exercises.

Stretch	Description
Calf stretch in standing	<p>Starting position. Standing facing a wall with the elbows extended and both palms on the wall at chest height. One leg is forward with the knee flexed and the other leg is back with the knee extended. Both feet are in full contact with the floor.</p> <p>Motion to apply stretch. Flex the front knee so that the trunk moves forward, keeping the trunk straight and the heels in contact with the floor.</p>
Hamstring stretch in standing	<p>Starting position. Standing facing a chair that is placed against a wall. Place one heel on the chair with the knee of that leg fully extended.</p> <p>Motion to apply stretch. Flex at the hips so that the trunk tilts forward, keeping the trunk straight. The foot on the floor should maintain full contact and the other heel remains in contact with the chair.</p>
Hamstring and calf stretch in sitting	<p>Starting position. Sit on the floor or a firm bed with both legs extended. Grasp toes with both hands.</p> <p>Motion to apply stretch. Flex at the hips so that the trunk tilts forward, keeping the trunk as straight as possible. Dorsiflex at the ankles.</p>

for one week. The participants received instructions on how to use the pedometer. The step count mechanism in this pedometer has elsewhere been shown to give values consistently within 3% of the actual steps taken during a self-paced walk, with Cronbach's Alpha of 0.99 for intra-model reliability (Schneider et al 2003). Participants were strongly encouraged not to make any changes to their typical daily routine of work and leisure activity. Patients were instructed to wear the pedometer for seven days and to record daily the number of steps and the number of minutes that they cycled, swam, or participated in any other activity. Non-ambulatory activities were converted into steps based on the intensity of the physical activity calculated in metabolic equivalents per minute (MET/min). For example, one minute of cycling or swimming translates to about 150 steps, whereas one minute of moderate fitness-related activity corresponds to about 100 steps. Steps per day, including converted steps, were expressed as step equivalents. Functional leg strength was measured with the chair-stand test which assesses leg strength, and is commonly used in generally active, community-dwelling older adults (Jones et al 2000). In this test, older adults stand up from a sitting position in a chair as often as they can in 30 seconds. The chair-stand test has a reliability (test-retest) of $r = 0.88$ and a convergent validity of $r = 0.75$.

Participants

To be included in the study, respondents to the study advertisement had to be over 55 years old and to experience regular episodes of nocturnal leg cramps, defined as at least once per week. Potential participants were excluded if they were using quinine or medication to assist sleep. They were also excluded if they had orthopaedic problems, severe medical conditions, or comorbidities known to cause muscular spasms or cramps.

Intervention

Participants in the experimental group attended a 45-min visit at which they were taught a program of daily stretching exercises for the hamstring and calf muscles by one physiotherapist, who was specially trained in the study procedures. Participants were advised to perform the stretches in standing, as presented in Figure 1a and b and described in Box 1. For each stretch, the participant was advised to adopt the position shown, move to the comfortable limit of motion, move beyond this to until a moderately intense stretch was felt and sustained for 10 seconds, and then return to the starting position. Participants were instructed to remain calm and never to hold their breath during the stretch. Each stretch was performed a total of three times, with 10 seconds of relaxation between each stretch. Stretching of both legs was done within three minutes. The physiotherapist demonstrated the stretches first and then observed the participant performing the stretches, correcting the technique if necessary. If a participant found stretching in standing difficult, the participant was shown how to stretch in a sitting position, as presented in Figure 1c and described in Box 1.

The control group were not taught any sham stretches and were advised not to commence stretches.

All participants were encouraged to maintain all other usual activity unchanged. At week 4, all participants received a home visit to assess and encourage adherence to the study protocol.

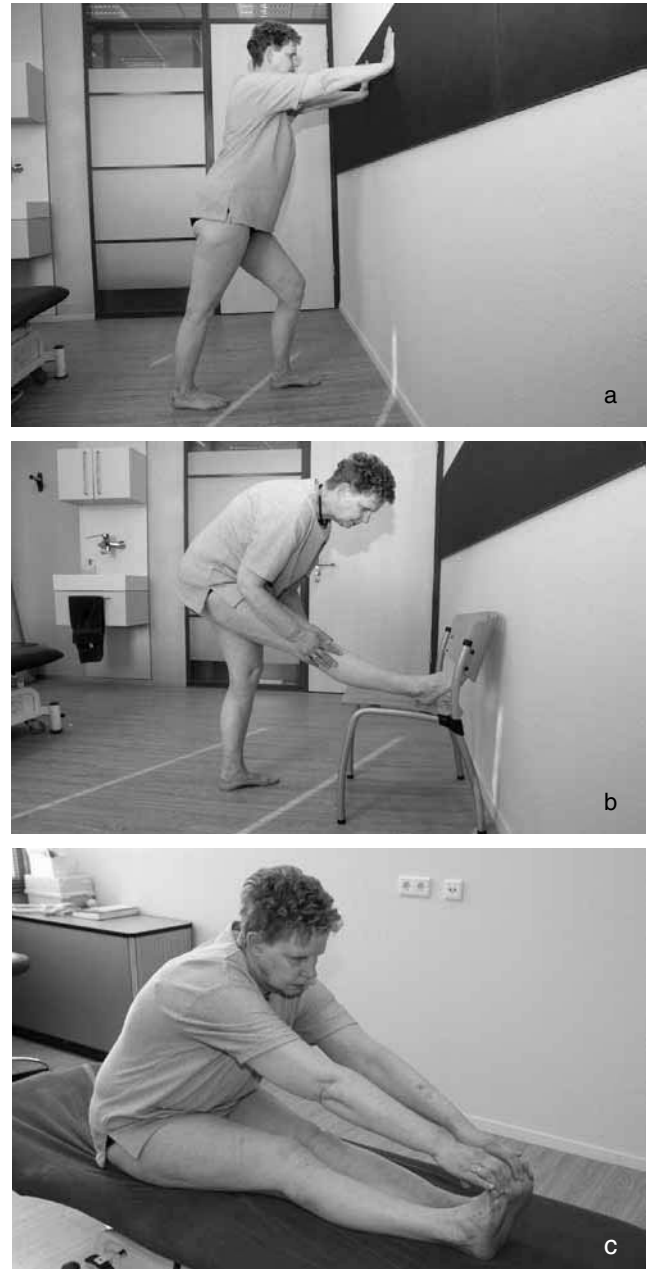


Figure 1. Stretches used in the experimental group: (a) calf stretch in standing, (b) hamstring stretch in standing, (c) hamstring and calf stretch in sitting.

Outcome measures

At an instruction visit prior to starting the study, participants were instructed in the daily recording of the frequency and severity of nocturnal leg cramps. The primary outcome was the change in the average number of nocturnal leg cramps per day over a one-week period. This was assessed in the week prior to starting the 6-week stretching program (Week 0) and again in the final week of the stretching program (Week 6).

The secondary outcome was the severity of nocturnal leg cramps. The severity was marked by the participants on a 10-cm visual analogue scale with 0 cm representing no pain and 10 cm representing the worst pain the participant could imagine. Recordings were again made in the daily diary over the same 1-week periods before and at the end of the

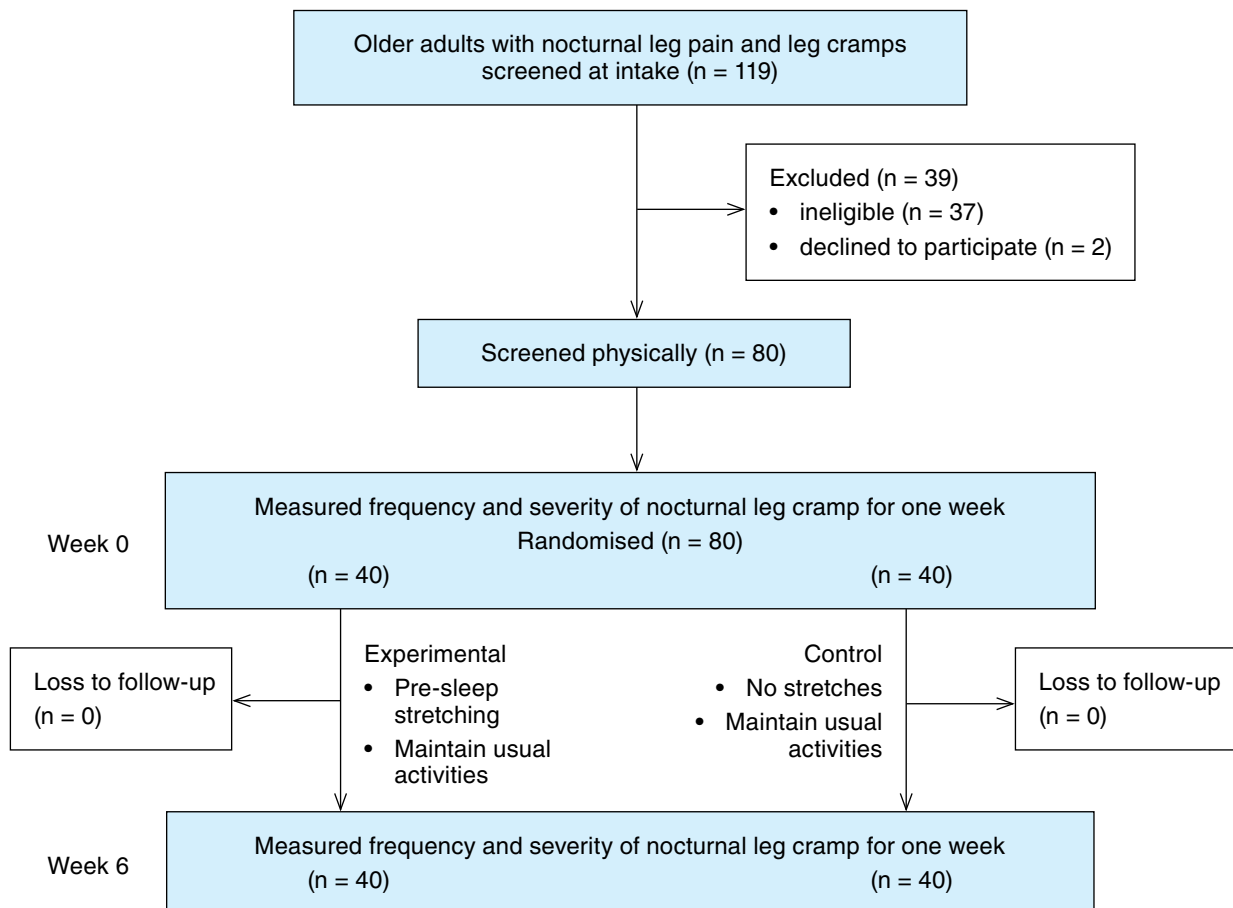


Figure 2. Design and flow of participants through the trial.

Table 1. Baseline characteristics of participants.

Characteristic	Randomised		Total
	Exp (n = 40)	Con (n = 40)	(n = 80)
Age (yr), mean (SD)	67 (7)	72 (7)	70 (6)
Gender, n males (%)	20 (50)	26 (65)	46 (58)
BMI (kg/m^2), mean (SD)	26.0 (3.0)	24.9 (3.8)	25.4 (3.6)
≥1 chronic disorder, n (%)	9 (23)	9 (23)	18 (23)
Physical activity (steps/d), mean (SD)	7780 (2644)	7956 (3810)	7868 (3259)
Site of nocturnal cramps, n (%)			
calf	11 (28)	9 (23)	20 (25)
hamstrings	2 (5)	4 (10)	6 (8)
calf and hamstrings	17 (43)	17 (43)	34 (43)
whole leg	10 (25)	10 (25)	20 (25)
Cramp duration (mo), mean (SD)	10 (8)	12 (14)	11 (12)
Chair-stand test (stands/30 s), mean (SD)	12 (3)	12 (3)	12 (3)

Table 2. Mean (SD) of groups, mean (SD) difference within groups, and mean (95% CI) difference between groups for both outcomes.

Outcome	Groups				Difference within groups		Difference between groups
	Week 0		Week 6		Week 6 minus Week 0		Week 6 minus Week 0
	Exp (n = 40)	Con (n = 40)	Exp (n = 40)	Con (n = 40)	Exp	Con	Exp minus Con
Cramp frequency (cramps/night), mean (SD)	3.4 (1.5)	3.2 (1.9)	1.4 (1.4)	2.4 (1.7)	-2.0 (1.3)	-0.8 (1.3)	-1.2 (-0.6 to -1.8)
Cramp severity (0 to 10), mean (SD)	7.2 (1.4)	7.4 (1.3)	5.9 (1.4)	7.5 (1.3)	-1.3 (1.1)	0.0 (0.9)	-1.3 (-0.9 to 1.7)

Exp = experimental group, Con = control group, shaded row = primary outcome

6-week stretching program. If adverse events were present, they were recorded daily in the diary card throughout the trial.

Data analysis

We sought to identify a difference in the average number of nocturnal leg cramps of 1 cramp per night. Anticipating a standard deviation of 1.4 cramps per night (Coppin et al 2005), we calculated that we would require 32 participants per group to have 80% power to detect this difference as significant with an alpha of 5%. To allow for drop outs, we increased the total sample size to 80 participants.

All participants were analysed according to their group allocation, ie, using an intention-to-treat analysis. For each outcome, the difference between the experimental and control groups in the change from baseline to post-intervention was calculated as a mean difference. Statistical significance was set at $p < 0.05$, so these mean differences are presented with 95% confidence intervals.

Results

Flow of participants through the trial

In total, 119 people responded to the study advertisement. Telephone screening of these respondents identified 39 as ineligible or unwilling to participate. The remaining 80 participants were randomised into the experimental or control group and completed the study, with 40 being allocated to each group. The flow of participants through the trial and reasons for exclusion are presented in Figure 2. The baseline characteristics of the participants are presented in Table 1 and the first two columns of Table 2.

Compliance with trial method

All participants completed their diary cards at Weeks 0 and 6 and reported that they maintained their usual daily activities throughout the study. No participants used quinine for the duration of the study.

Effect of intervention

Group data for all outcomes are presented in Table 2. Individual data are presented in Table 3 (see eAddenda for Table 3). The frequency of nocturnal leg cramps reduced in

both groups over the 6-week intervention period. However, the reduction in frequency was significantly greater in the experimental group, by a mean of 1.2 cramps per night (95% CI 0.6 to 1.8).

The severity of nocturnal leg cramps did not improve at all in the control group. However, there was a substantial reduction in the experimental group. The mean difference in improvement in the severity of the nocturnal leg cramps was 1.3 cm on the 10-cm visual analogue scale.

No adverse events were reported in either group.

Discussion

Our results showed that six weeks of nightly stretching of the calf and hamstring muscles significantly reduced the frequency and severity of nocturnal leg cramps in older people. The best estimate of the average effect of stretching on the frequency of cramps was a reduction of about one cramp per night. Given that participants had an average of approximately three cramps per night at the beginning of the study, this is a substantial effect and approximately equal to the effect we nominated as worthwhile. Since the stretches are quick and simple to perform, some patients may even consider the weakest effect suggested by the limit of the confidence interval (a reduction of 0.6 cramps per night) to be worthwhile.

The stretches reduced the severity of the pain that occurred with the nocturnal leg cramps by 1.3 cm on a 10-cm visual analogue scale. We do not know the smallest effect on the severity of the cramps that patients typically feel would make the stretches worthwhile. In other research using the 10-cm visual analogue scale for pain, a change score of 2 cm has been proposed in chronic low back pain patients (Ostelo and de Vet 2005). An effect of this magnitude was not achieved in our study within the 6-week intervention period. However, the confidence interval around this result is reasonably narrow. Therefore patients can be advised that the average effect of the stretches is to reduce the severity of the pain by 1.3 cm on the 10-cm scale (or close to this value). Patients can then decide for themselves whether this effect – in addition to the reduced frequency of the cramps – makes the stretches worth doing.

In this trial, stretching was performed at home and was patient-centred. This facilitated performance of the intervention, which may have aided adherence with the stretches and increased the effectiveness of the intervention. In this setting, however, correct execution of the stretching technique was not closely monitored. All the participants in the experimental group did two exercises, regardless of whether the cramp was located in the hamstrings or calf. Greater effects may perhaps be achievable if stretches were to be targeted at the site(s) of each participant's cramps. This could be investigated in a future trial.

The results of this study are consistent with those of the uncontrolled study by Daniell and colleagues (1979), which suggested that stretching exercises were effective in preventing the occurrence of nocturnal leg cramps. Conversely, our results differ from those of Coppin and colleagues (2005), who concluded that a stretching intervention failed to significantly relieve the intensity and frequency of nocturnal leg cramps. Some details of that stretching regimen, such as the exact time of day at which stretching was performed, remain unclear. However, the different result in our study may be attributable to differences in the time of day, the number of repetitions of the stretch, and the different eligible populations (users versus non-users of quinine).

One possible limitation of this study is that the test results were obtained using self-reported 'measurements' in a daily diary. Progress in the control group might be due to the Hawthorne effect (Adair 1984). In addition, selection bias may have affected our results due to the preferences of the participants to participate in this study. Difference in the ages of both groups also may have caused bias, which could have been reduced through a pre-stratification procedure. However, the study design incorporated several features to reduce the risk of bias in the results, the necessary sample size was calculated and obtained, and no dropouts occurred during the follow-up.

Despite some potential limitations, the results of the study are promising for use in physical therapy settings; even though it only considered the context of the increasing number of older adults with nocturnal leg cramps, a physical therapy consultation might be an effective option. More evidence is needed to validate the long-term effects of stretching on nocturnal leg cramps. ■

Footnotes: ^aDigiwalker SW-200, Yamax, Tokyo, Japan.

eAddenda: Table 3 available at jop.physiotherapy.asn.au

Ethics: The University Medical Center Groningen Ethics Committee(s) approved this study. All participants gave written informed consent before data collection began.

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Competing interests: None declared.

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